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PATENT ABSTRACTS OF JAPAN

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(54) GROUP-III NITRIDE SEMICONDUCTOR LIGHT-EMITTING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain high luminance emission from green to blue and to obtain the emission of various colors only with a group-III nitride semiconductor.
SOLUTION: A light emitting diode 10 is constituted by a sapphire substrate 1, a buffer layer 2, a high carrier density n+ layer 3, an n-layer 4 made of Al0.3Ga0.7N, a light-emitting layer 5, a p-layer 61 made of Al0.3Ga0.7N and doped with Mg, a contact layer 62 made of GaN and doped with Mg, an electrode 7 made of Ni and an electrode 8. The light-emitting layer 5 has a multiplex quantum well structure where the barrier layer 51 of six layers, which is made of Al0.25Ga0.75N whose film thickness is about 100Å, and the barrier well layer 52 of five layers, which is made of Al0.2Ga0.8N whose film thickness is 100Å, are alternately formed. Zinc and silicon are added to the density of 5×1018/cm3 to the well layer 52. The light-emitting layer 5 emitting such ultraviolet rays and a fluorescent substance layer receiving the ultraviolet rays which the light- emitting layer 5 radiates and converting it into the visible light on the electrode 7 are provided.

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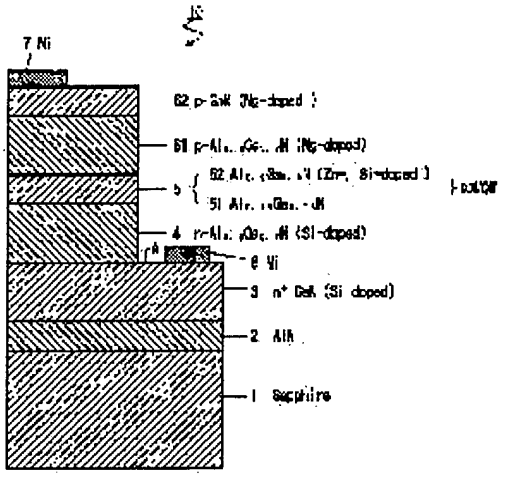

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CLAIMS

[Claim(s)]
[Claim 1] The light emitting device characterized by preparing the luminous layer which emits light in ultraviolet rays, and the fluorescent substance layer which receives the aforementioned ultraviolet rays to which the aforementioned luminous layer emanates, and is changed into the light in the light emitting device which used 3 group nitride semiconductor for the luminous layer.
[Claim 2] The aforementioned fluorescent substance layer is a light emitting device according to claim 1 characterized by being formed in the lens object for emitting light outside.
[Claim 3] It is the light emitting device according to claim 1 which has an electrode layer for supplying electric power to the aforementioned luminous layer, and is characterized by forming the aforementioned fluorescent substance layer on the electrode layer.
[Claim 4] It is the light emitting device according to claim 1 which has silicon on sapphire for forming the aforementioned luminous layer, and is characterized by the aforementioned fluorescent substance layer being formed in the field of an opposite side by the formation side of the aforementioned luminous layer of the silicon on sapphire.
[Claim 5] The aforementioned fluorescent substance layer is a light emitting device according to claim 1 characterized by being formed in the side of the aforementioned luminous layer.
[Claim 6] the well layer to which the aforementioned luminous layer changes from Alx1GaY1In1-X1-Y1N, and this well layer -- latus Alx2GaY2In1-X2-Y2N of forbidden-band width of face from -- light emitting device according to claim 1 characterized by having consisted of quantum wells to which the

laminating of the barrier layer which changes was carried out alternately [at least one or more layer], and adding acceptor impurity and a donor impurity to the aforementioned luminous layer
[Claim 7] The light emitting device according to claim 6 characterized by both the aforementioned acceptor impurity and the aforementioned donor impurity being added by each well layer or each well layer, and each barrier layer of the aforementioned luminous layer.
[Claim 8] The light emitting device according to claim 6 characterized by the aforementioned acceptor impurity and the aforementioned donor impurity being added by turns by the well layer which the aforementioned luminous layer adjoins.
[Claim 9] The light emitting device according to claim 6 to which the aforementioned acceptor impurity is conversely characterized by for the aforementioned donor impurity being added by the aforementioned well layer, and the aforementioned acceptor impurity being added for the aforementioned donor impurity by the aforementioned barrier layer at the aforementioned barrier layer of the aforementioned luminous layer, respectively at the aforementioned well layer of the aforementioned luminous layer.
[Claim 10] the aforementioned barrier layer -- GaN from -- light emitting device according to claim 6 characterized by changing
[Claim 11] The aforementioned well layer and the aforementioned barrier layer are a light emitting device according to claim 6 characterized by the lattice constant being in agreement.
[Claim 12] The aforementioned luminous layer is inserted by p layers of p conduction type, and n layers of n conduction type, and is thickly constituted from diffusion length of an electron hole. Alx3GaY3In1-X3-Y3N by which the becoming donor impurity on which the aforementioned luminous layer and a lattice constant spread the n aforementioned layers in abbreviation etc. was added It constitutes from a semiconductor. The light emitting device according to claim 1 characterized by constituting from an Alx4GaY4In1-X4-Y4N semiconductor with which acceptor impurity with larger forbidden-band width of face than the aforementioned luminous layer was added as enough to shut up the electron into which the p aforementioned layers were poured by the aforementioned luminous layer.
[Claim 13] The n aforementioned layers are GaN by which the aforementioned luminous layer was constituted from GaY5In1-Y5N (0.92 <=Y5 <=1), and the donor impurity was added. Light emitting device according to claim 11 characterized by being constituted.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the semiconductor light emitting device using 3 group nitride semiconductor which can set up the luminescent color arbitrarily.
[0002]
[Description of the Prior Art] InGaN from which blue luminescence is obtained conventionally The used semiconductor light emitting device is known. Furthermore, in order to obtain green luminescence of long wavelength more by this light emitting device, and to narrow forbidden-band width of face of a luminous layer, enlarging the composition ratio of In is performed.
[0003]
[Problem(s) to be Solved by the Invention] However, if the composition ratio of In is enlarged, the crystallinity of a luminous layer will get worse and luminous efficiency will fall. Therefore, it takes for

lengthening luminescence wavelength, luminescence brightness becomes low, and luminescence of the blue shell green of high brightness is not yet obtained. Moreover, when various kinds of luminescent color was obtained, the semiconductor material of forbidden-band width of face was used for the wavelength of the luminescent color considerable the bottom.
[0004] this invention is only 3 group nitride semiconductor, and is obtaining luminescence of various kinds of colors while it accomplishes in order to solve the above-mentioned technical problem, and the purpose obtains luminescence of the blue shell green of high brightness.
[0005]
[Means for Solving the Problem] According to invention of a claim 1, the luminous layer using 3 group nitride semiconductor which emits light in ultraviolet rays, and the fluorescent substance layer which receives the ultraviolet rays to which the luminous layer emanates, and is changed into the light are prepared. Therefore, since a fluorescent substance is excited by the ultraviolet rays of wavelength shorter than the light, it can only change the quality of the material of a fluorescent substance, and can obtain the light of various kinds of colors.
[0006] The ultraviolet rays from a luminous layer are changed into the light by the fluorescent substance layer by which invention of a claim 2 was formed in the lens object, the fluorescent substance layer by which invention of a claim 3 was formed on the electrode layer, the fluorescent substance layer formed in the silicon-on-sapphire side where invention of a claim 4 is transparent, and the fluorescent substance layer by which invention of a claim 5 was formed in the side of a luminous layer. All can change the luminescent color only by changing the kind of fluorescent substance of a fluorescent substance layer.
[0007] Claims 6-13 are related with the luminous layer which emits ultraviolet rays. By invention of claims 6-11, it is AlGaInN about a luminous layer. It considered as the quantum well structure which carried out the at least one or more layer laminating, and a donor impurity or acceptor impurity was added to the luminous layer. For this reason, since the recombination probability of an electron and a hole which contributes to luminescence since donor level or acceptor level is formed increases, the luminous efficiency by reunion improves. Moreover, the composition ratio and high impurity concentration of an indium are determined by the relation between the emission peak wavelength to wish and luminescence intensity.
[0008] Especially, it is InGaN to a luminous layer. Crystalline good AlGaN It uses, and by making a luminous layer into the distorted superlattice of quantum well structure, propagation of the misfit of a lattice constant was able to be prevented, the crystallinity of a well layer was able to be raised, and, thereby, luminous efficiency was able to be raised. Especially, both acceptor impurity and the donor impurity were able to be added in the crystalline good well layer, and the luminous efficiency of ultraviolet rays was able to be greatly raised by opposite luminescence by acceptor level and donor level.
[0009] In addition, the mol composition ratio of aluminum of a luminous layer considers as 15% or more, and well layer thickness has the desirable range of 50A - 200A. Since the quantum effect stops occurring when impurity diffusion will happen if it is 50A or less, and it is 200A or more, it is not desirable. Moreover, barrier layer thickness has the desirable range of 50A - 200A. Since the efficiency which confines a carrier in a well layer will fall if it is 50A or less, since the quantum effect stops occurring when it is 200A or more, it is not desirable desirably. Since resistance becomes large in the case of a non dope, and the crack by transposition will enter when it dopes if it is 200A or more, it is not desirable.
[0010] Moreover, the concentration of the acceptor impurity added to a luminous layer and a donor impurity is three to 1x1020/cm3 of 1x1017-/cm. The range is desirable. 1x1017-/cm3 Luminous efficiency falls that it is the following with the shortage of an emission center, and it is 1x1020-/cm3. If it becomes the above, since crystallinity will become bad and the Auger effect will occur, it is not desirable.
[0011] Moreover, so that a luminous layer and a lattice constant may spread abbreviation etc. and n layers may become in invention of a claim 12 Alx3GaY3In1-X3-Y3N composition ratios X3 and Y3 They are the Alx4GaY4In1-X4-Y4N composition ratios X4 and Y4 so that p layers may fully shut up the electron poured in from n layers to the luminous layer and forbidden-band width of face may become large by being determined only in ****. It is determined. Thus, by determining n layers, there is little misfit by difference of the lattice constant of n layers and a luminous layer, and the crystallinity of a luminous layer improves.
[0012] The obstruction by junction to n layers and a luminous layer carries out the operation which shuts up the electron hole poured into the luminous layer from p layers. However, the diffusion length of an electron hole is several 1000A, and the luminous layer consists of the diffusion length thickly. therefore, the obstruction by junction to n layers and a luminous layer -- the inside of the luminous layer of an electron hole -- it does not contribute effective in shutting up therefore -- since the obstruction between n layers and a luminous layer may be small -- n layers -- a luminous layer -- receiving -- a lattice constant --

abbreviation -- it becomes equal -- as -- Alx3GaY3In1-X3-Y3N composition ratios X3 and Y3 By determining, the grid mismatching between n layers and a luminous layer can be made small as much as possible, and it becomes possible to raise the crystallinity of a luminous layer. Consequently, the luminous efficiency of ultraviolet rays improves.
[0013] the case where a luminous layer is constituted from GaY5In1-Y5N (0.92 <=Y5 <=1) since light is emitted in ultraviolet rays -- n layers -- GaN **, by carrying out, grid mismatching can be made small
[0014] moreover, GaN by which silicon was added by the high concentration which the above-mentioned light emitting diode forms a buffer layer on silicon on sapphire, and functions as a lead of the current over n layers on it from -- n+ which changes A layer can also be formed. In this case, it is GaN about n layers. It is constituting and is n+. The lattice constant of a layer and n layers is completely in agreement, and misfit transposition is not generated. Therefore, the crystallinity of a luminous layer improves more.
[0015]
[Embodiments of the Invention] The structure of the light emitting diode which emits light in ultraviolet rays is explained. In drawing 1 , light emitting diode 10 has silicon on sapphire 1, and it is AlN of 500 ** on the silicon on sapphire 1. The buffer layer 2 is formed. the buffer-layer 2 top -- order -- thickness 2.0 [about] mum and silicon dope GaN of 2x1018/of concentration of electrons cm 3 from -- high carrier concentration n+ which changes A layer 3 and thickness 1.0 [about] mum -- concentration of electrons aluminum0.3Ga0.7N of the silicon dope of 2x1018-/cm3 from -- n layers of 4 and the luminous layers 5 of about 0.11 micrometers of all thickness which change, and thickness 1.0 [about] mum -- aluminum0.3Ga0.7N by which magnesium was doped by 5x1017/of hole concentration cm 3, and 1x1020/of concentration cm 3 from -- p layer 61 and thickness 0.2 [about] which change mum -- hole concentration 7x1017-/cm3 and magnesium concentration GaN of the magnesium dope of 2x1020-/cm3 from -- the contact layer 62 which changes is formed And the electrode 7 which consists of nickel joined to the contact layer 62 is formed on the contact layer 62. Furthermore, high carrier concentration n+ A part of front face of a layer 3 is exposed, and the electrode 8 which consists of nickel joined to the layer 3 is formed on the outcrop.
[0016] aluminum0.2Ga0.8N of the six-layer barrier layer 51, and thickness about 100 ** which consists of aluminum0.25Ga0.75N of thickness about 100 ** as the detailed composition of a luminous layer 5 is shown in drawing 2 from -- the five-layer well layer 52 which changes is the multiplex quantum well structure by which the laminating was carried out by turns, and are about 0.11 micrometers of all thickness Moreover, zinc and silicon are added by the well layer 52 at the concentration of 5x1018-/cm3, respectively.
[0017] Next, the manufacture method of the light emitting diode 10 of this structure is explained. The above-mentioned light emitting diode 10 is an organometallic compound vapor growth (it is described as "M0VPE" below). It was manufactured by the vapor growth to depend. The used gas NH3, a silane (SiH4), and diethylzinc Carrier gas H2 or N2 () Trimethylgallium (Ga3 (CH3)) (it is described as "TMG" below) Trimethylaluminum (aluminum3 (CH3)) (it is described as "TMA" below) It is described as "DEZ" below. It is magnesium cyclopentadienyl (Mg2 (C5H5)) (it is described as "CP2Mg" below).
[0018] First, thickness 100-400 which makes a principal plane the a-th page washed with organic washing and heat treatment It is M0VPE about the silicon on sapphire 1 of the single crystal of mum. The susceptor laid in the reaction chamber of equipment is equipped. Next, gas phase etching of the silicon on sapphire 1 was carried out at the temperature of 1100 degrees C, passing H2 to a reaction chamber by part for rate-of-flow 2 liter/by the ordinary pressure.
[0019] Next, temperature It is made to fall to 400 degrees C, and they are a part for 20 liter/, and NH3 about H2. A part for 10 liter/, and TMA It supplies by part for 1.8x10 -five-mol/, and is AlN. A buffer layer 2 is abbreviation. It was formed in the thickness which is 500A. The temperature of silicon on sapphire 1 is held at 1150 degrees C. H2 A part for next, 20 liter/, NH3 A part for 10 liter/, and TMG It is 0.86 ppm by part for 1.7x10-4 RU/, and H2 gas. The diluted silane is supplied by part for 200ml/for 30 minutes. thickness 2.2 [about] mum and concentration of electrons GaN of the silicon dope of 2x1018-/cm3 from -- high carrier concentration n+ which changes The layer 3 was formed.
[0020] The temperature of silicon on sapphire 1 is held at 1100 degrees C. N2 or H2 A part for next, 10 liter/, NH3 A part for 10liter/, and TMG 1.12x10 -four-mol a part for /and TMA It is 0.86 ppm by part for 0.47x10 -four-mol/, and H2 gas. The diluted silane by part for 10x10-9mol/ 60 minutes -- supplying -- thickness 1 [about] aluminum0.3Ga0.7N of mum and the silicon dope of 1x1018/of concentration cm 3 from -- n layer 4 which changes was formed

[0021] then, the temperature of silicon on sapphire 1 -- 1100 degrees C -- holding -- N2 or H2 -- a part for 20 liter/, and NH3 A part for 10 liter/, and TMG 1x10 -five-mol a part for /and TMA a part for 0.39x10 -four-mol/-- for 3 minutes -- introducing -- aluminum0.25Ga0.75N from -- the barrier layer 51 with a thickness of 100A which changes was formed Next, they are a part for 20 liter/, and NH3 about N2 or H2. A part for 10 liter/, and TMG 1x10 -five-mol a part for /and TMA By part for 0.31x10 -four-mol/ And it is 0.86 ppm by H2 gas. They are a part for 10x10-9mol/, and DEZ about the diluted silane. By part for 2x10 -four-mol/ for 3 minutes -- introducing -- aluminum0.2Ga0.8N from -- silicon with a thickness of 100A which changes, and zinc formed the well layer 52 added by the concentration of 5x1018-/cm3, respectively By the repeat of such a procedure, as shown in drawing 2 , only the barrier layer 51 and five layers of well layers 52 were ******(ed) by turns, and the luminous layer 5 with a whole thickness of 0.11 micrometers was formed with multiplex quantum well structure.

[0022] Temperature is held at 1100 degrees C. N2 or H2 A part for then, 20 liter/, NH3 A part for 10liter/, and TMG A part for 1.12x10 -four-mol/, TMA 0.47x10 -four-mol a part for /and CP2Mg a part for 2x10 -four-mol/-- for 60 minutes -- introducing -- thickness 1.0 [about] aluminum0.3Ga0.7N of the magnesium (Mg) dope of mum from -- p layer 61 which changes was formed p layers of concentration of the magnesium of 61 are 1x1020-/cm3. In this state, 61 is still resistivity 108 p layers. It is an insulator more than omegacm.

[0023] Then, temperature was held at 1100 degrees C and the contact layer 62 which consists N2 or H2 of a part for 20 liter/and NH3 was formed. A part for 10liter/, and TMG 1.12x10 -four-mol a part for /and CP2Mg At 4x10 -four-mol the rate for / It introduces for 4 minutes and is thickness 0.2 [about]. GaN of the magnesium (Mg) dope of mum Concentration of the magnesium of the contact layer 62 It is 2x1020-/cm3. In this state, the contact layer 62 is still resistivity 108. It is an insulator more than omegacm.

[0024] Thus, the wafer of the cross-section structure shown in drawing 2 was obtained. Next, this wafer was heat-treated for 45 minutes at 450 degrees C. By this heat treatment, 61 is hole concentration 62 or p layers of contact layers, respectively. 7x1017-/cm3, 5x1017-/cm3, resistivity 2-ohmcm and 0.8 omegacm It became p conduction-type semiconductor. Thus, the wafer of multilayer structure was obtained.

[0025] next, it is shown in drawing 3 -- as -- the contact layer 62 top -- sputtering -- SiO two-layer -- 9 was formed in the thickness of 2000A and the photoresist 10 was applied on the SiO two-layer 9 And by Fort Lee SOGURAFU, as shown in drawing 3 , it sets on the contact layer 62, and it is high carrier concentration n+. Electrode formation part A' to a layer 3 The photoresist 10 was removed. next, the SiO two-layer which is not covered by the photoresist 10 as shown in drawing 4 -- 9 was removed by the hydrofluoric-acid system etching reagent

[0026] Next, 62 or p layer 61 and 5 or n layers of luminous layers of contact layers of the part which is not covered by a photoresist 10 and SiO two-layer 9, after supplying and carrying out dry etching of degree of vacuum 0.04Torr, RF power 0.44 W/cm2, and the BCl3 gas at a rate for 10 ml/, dry etching of 4 was carried out by Ar. this process shows to drawing 5 -- as -- high carrier concentration n+ the hole for electrode drawing to a layer 3 -- A was formed

[0027] Next, as the vacuum evaporationo of the nickel is carried out uniformly and it is shown in drawing 1 through the application of a photoresist, a photolithography process, and an etching process all over the upper [of a sample], it is high carrier concentration n+. The electrodes 8 and 7 to a layer 3 and the contact layer 62 were formed. Then, like the above, the processed wafer was cut for each chip and the light emitting diode chip was obtained.

[0028] Thus, the obtained light emitting device is 20mA of drive current, and is an emission peak wavelength. It was 2mW in 380nm and luminescence intensity. This luminous efficiency is 3% and improved by 10 times compared with the thing of the conventional composition.

[0029] In the above-mentioned example, the band gap of the barrier layer 51 of a luminous layer 5 is formed in a double heterojunction which exists in both sides and which becomes smaller than the band gap of 4 n layers with 61 p layers. Although double heterojunction structure was used in the above-mentioned example, you may be single heterojunction structure. Furthermore, although heat treatment was used for forming p layers, you may form p mold by electron beam irradiation.

[0030] Although the above-mentioned light emitting diode 10 has added zinc and silicon simultaneously in each well layer 52, each well layer 52 and each barrier layer 51 may add acceptor impurity, such as zinc, and donor impurities, such as silicon. Moreover, as shown in drawing 6 , the luminous layer 5 of light emitting diode 100 may add silicon and zinc by turns in order in two or more well layers 520. In this structure, opposite luminescence by acceptor level and donor level is attained, and the luminous efficiency of ultraviolet rays improves. Thus, the obtained light emitting device is 20mA of drive current, and is an

emission peak wavelength. It was 5mW in 380nm and luminescence intensity. This luminous efficiency is 7% and improved by 25 times compared with the thing of the conventional composition.
[0031] Moreover, as shown in drawing 7 , what added zinc in all the well layers 521, and added silicon in all the barrier layers 511 is sufficient as light emitting diode 200. In this structure, opposite luminescence by acceptor level and donor level is attained, and the luminous efficiency of ultraviolet rays improves. In addition, silicon is added in all the well layers 521, and you may make it add zinc in all the barrier layers 511 conversely. Thus, the obtained light emitting device is 20mA of drive current, and is an emission peak wavelength. It was 5mW in 370nm and luminescence intensity. This luminous efficiency is 7% and improved by 25 times compared with the thing of the conventional composition.
[0032] Furthermore, although magnesium is not added by the barrier layer 51,510,511, you may form all the above-mentioned light emitting diodes into p mold by heat treatment or electron-beam-irradiation processing after adding magnesium. Thus, the obtained light emitting device is 20mA of drive current, and is an emission peak wavelength. It was 10mW in 380nm and luminescence intensity. This luminous efficiency is 15% and improved by 50 times compared with the thing of the conventional composition.
[0033] Furthermore, it is good also as composition as shows light emitting diode 300 to drawing 8 . namely, the light emitting diode 300 -- thickness 5.0 [about] mum and concentration Silicon dope GaN of 5x1018-/cm3 from -- high carrier concentration n+ which changes A layer 30 and thickness 0.5 [about] mum -- concentration GaN of the silicon dope of 5x1017-/cm3 from -- n layers of 40 and the luminous layers 50 of about 0.41 micrometers of all thickness which change, and thickness 0.5 [about] mum -- 5x1017/of hole concentration cm 3, and concentration aluminum0.08Ga0.92N by which magnesium was doped by 5x1020-/cm3 from -- p layer 610 and thickness 1 [about] which change mum -- hole concentration 7x1018-/cm3 and magnesium concentration GaN of the magnesium dope of 5x1021-/cm3 from -- you may constitute from a contact layer 620 which changes
[0034] however, the detailed composition of a luminous layer 50 -- GaN of thickness about 100 ** from -- In0.07Ga0.93N of the 21-layer barrier layer 512, and thickness about 100 ** which changes from -- the 20-layer well layer 522 which changes is the multiplex quantum well structure by which the laminating was carried out by turns, and are about 0.41 micrometers of all thickness Moreover, silicon is added by the well layer 522 at the concentration of 5x1018-/cm3.
[0035] Thus, the obtained light emitting device was 20mA of drive current, and was 2mW in 380nm of emission peak wavelengths, and luminescence intensity. This luminous efficiency is 3% and improved by 10 times compared with the thing of the conventional composition.
[0036] in addition, the well layer 522 of a luminous layer 50 -- In0.07Ga0.93N although used -- aluminum0.03Ga0.89In0.08N etc. -- you may use 3 group nitride semiconductor of a system of 4 yuan Moreover, it is GaN to the barrier layer 512. Alx2GaY2In1-X2-Y2N which has bigger forbidden-band width of face than the forbidden-band width of face of the well layer 522 although used You may use a semiconductor. Moreover, the repeat number of layers of the multiplex quantum well of a luminous layer 50 can use one to about 20. Furthermore, as for the barrier layer 512 and the well layer 522, it is good to choose a composition ratio so that an abbreviation lattice constant may be made in agreement.
[0037] Moreover, the luminous layer of all the above-mentioned light emitting diodes is In0.07Ga0.93N of about 0.5 micrometers of thickness about a luminous layer 501, as it is shown in drawing 9 as other light emitting diodes 400, although considered as multiplex quantum well structure. You may constitute. The light emitting diode in this case was 20mA of drive current, and was 1mW in emission-peak-wavelength 380 nm and luminescence intensity. This luminous efficiency is 1.5% and improved by 5 times compared with the thing of the conventional composition. Although this luminous layer 501 has not added the impurity, you may add acceptor impurity, such as donor impurities, such as silicon, and zinc. A luminous layer 501 is thickness 0.5. Luminous efficiency is not reduced, even if it becomes thick and the obstruction between 40 and a luminous layer 501 is smaller than the diffusion length of an electron hole n layers, since it is made mum.
[0038] Moreover, the light emitting diode shown in drawing 8 and drawing 9 is n+. With n layers of layers 30, since 40 is [both] GaN, the grid mismatching between these layers does not exist. Therefore, the misfit dislocation by this grid mismatching does not occur in a luminous layer 50,501. Moreover, GaN In0.07Ga0.93N The grid mismatching of a between is small and the misfit dislocation of the luminous layer 50,501 accompanying the grid mismatching of 40 and a luminous layer 50 is n layers fewer than. Therefore, the crystallinity of a luminous layer became good.
[0039] Although double heterojunction structure was used in the above-mentioned example, you may be single heterojunction structure. Furthermore, although heat treatment was used for forming p layers, you

may form p mold by electron beam irradiation. Although the example of light emitting diode was shown, even if it is a laser diode, it can constitute similarly.
[0040] Thus, as shown in drawing 10 (light emitting diode represents and is shown by 10 drawing), after being attached in the flat part 203 of the upper part of lead 201, connecting lead 201 with an electrode 8 with a wire 204 and connecting lead 202 with an electrode 7 with a wire 205, in order to form a lens 206, resin fabrication of the formed light emitting diode 10,100,200,300,400 is carried out. Fluorescent paint is applied to the upper surface of this lens 206, and the fluorescent substance layer 207 is formed. The fluorescent substance of a fluorescent pigment, a fluorescent dye, and others can be used for the fluorescent substance layer 207. The arbitrary luminescent color can be obtained because only the matter of the fluorescent substance layer 207 changes this fluorescent substance layer 207, without changing arbitrary colors, for example, red, green, blue, then the quality of the material and structure of light emitting diode. as a fluorescent substance -- Zn0.2Cd0.8 S:Ag, Zn0.6Cd0.4 S:Ag, and 10(Sr, calcium) (PO4) 6CL2:Eu etc. -- it can use Moreover, they are ZnS:Cu and aluminum as a fluorescent substance of green luminescence. A fluorescent substance and Y2aluminum5O12:Tb It is Y2O3:Eu as a mixture with a fluorescent substance, and a fluorescent substance of red luminescence. They are ZnS:Ag and aluminum as the mixture of a fluorescent substance and a Y2O3 S:Eu fluorescent substance, and a fluorescent substance of blue luminescence. A fluorescent substance can also be used.
[0041] Moreover, as shown in drawing 11 , you may form the fluorescent substance layer 208 on the electrode 7 which is the best layer of light emitting diode 500. Furthermore, as shown in drawing 12 , in the case of the flip chip type light emitting diode 600, you may form the fluorescent substance layer 209 on field 1a of the side in which the luminous layer 5 of silicon on sapphire 1 is not formed. Furthermore, as shown in drawing 13 , you may form the fluorescent substance layer 210 which carries out incidence of the ultraviolet rays from a luminous layer 701 to the side of light emitting diode 700.

[Translation done.]

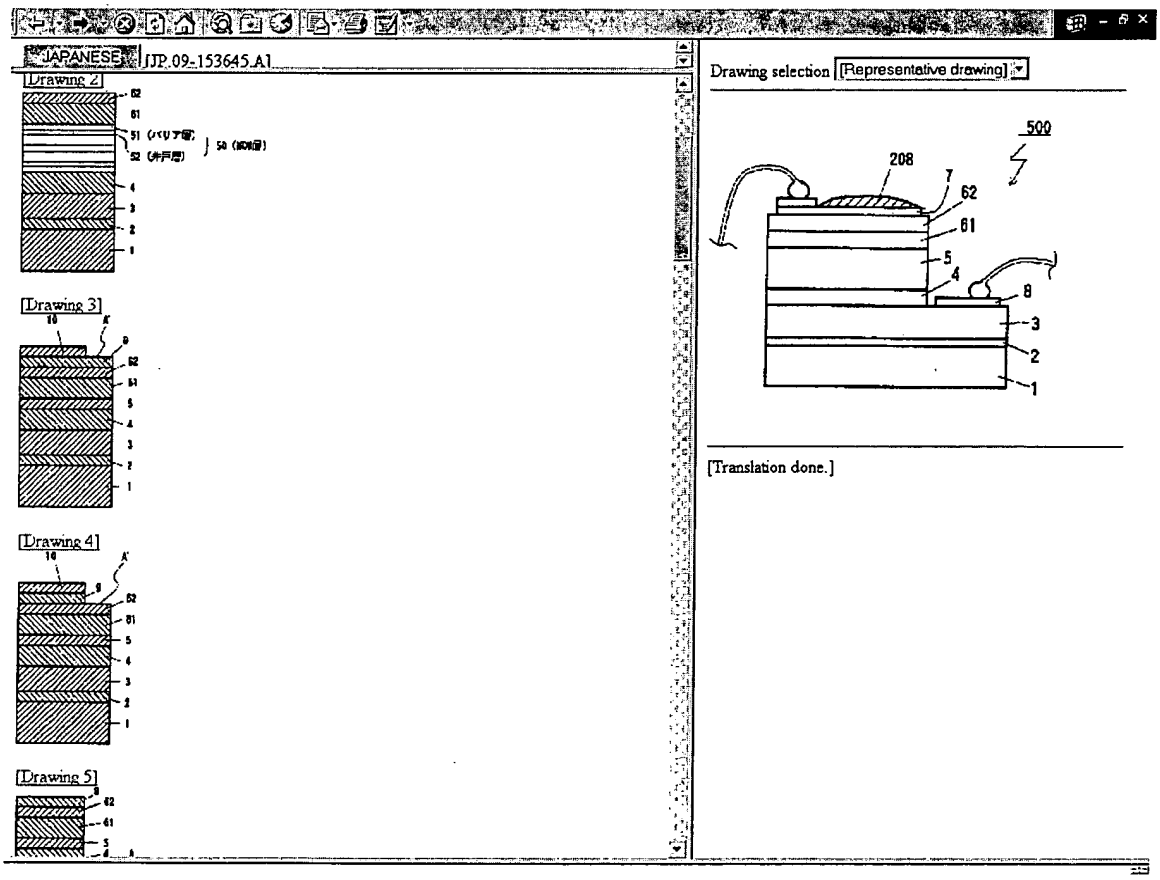
* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram having shown the composition of the light emitting diode used for the light emitting device concerning the concrete example of this invention.
[Drawing 2] The cross section having shown the manufacturing process of the light emitting diode of this example.
[Drawing 3] The cross section having shown the manufacturing process of the light emitting diode of this example.
[Drawing 4] The cross section having shown the manufacturing process of the light emitting diode of this example.
[Drawing 5] The cross section having shown the manufacturing process of the light emitting diode of this example.
[Drawing 6] The block diagram having shown the composition of the light emitting diode of other examples.
[Drawing 7] The block diagram having shown the composition of the light emitting diode of other examples.
[Drawing 8] The block diagram having shown the composition of the light emitting diode of other examples.

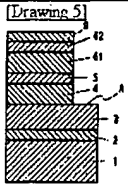
[Drawing 9] The block diagram having shown the composition of the light emitting diode of other examples.
[Drawing 10] The block diagram having shown the composition of a light emitting device with light emitting diode.
[Drawing 11] The block diagram having shown other composition of a light emitting device.
[Drawing 12] The block diagram having shown other composition of a light emitting device.
[Drawing 13] The block diagram having shown other composition of a light emitting device.
[Description of Notations]
10, 100, 200, 300, 400,500,600,700 -- Light emitting diode
1 -- Silicon on sapphire
2 -- Buffer layer
3 30 -- Quantity carrier concentration n+ Layer
4 40--n layers
5 50,501,701 -- Luminous layer
51,510,511,512 -- Barrier layer
52,520,521,522 -- Well layer
61,610--p layers
62,620 -- Contact layer
7 8 -- Electrode
207,208,209,210 -- Fluorescent substance layer

[Translation done.]

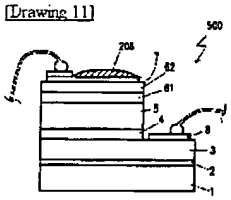


JAPANESE | [JP,09-153645,A]

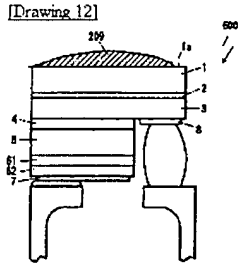
[Drawing 5]



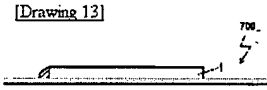
[Drawing 11]



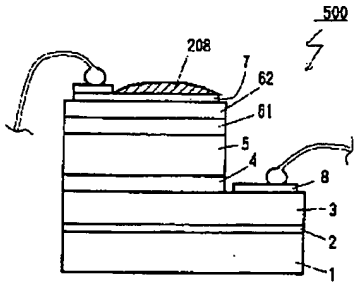
[Drawing 12]



[Drawing 13]



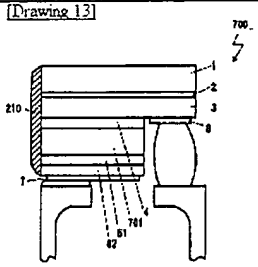
Drawing selection [Representative drawing]



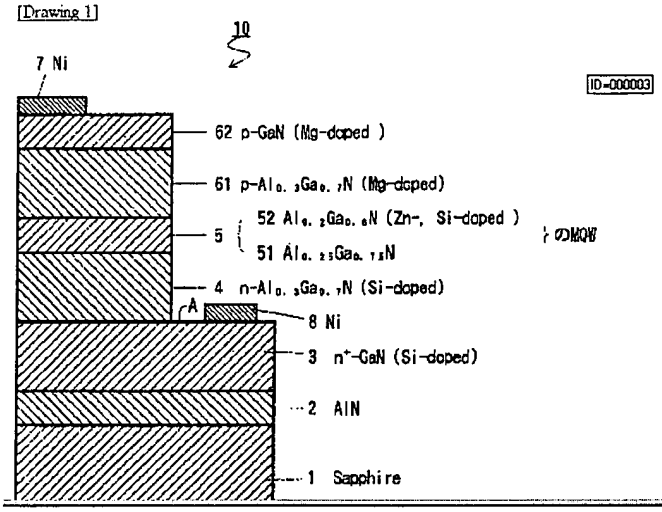
[Translation done.]

JAPANESE | JP.09-153645.A1

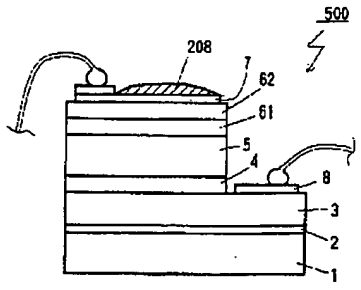
[Drawing 13]



[Drawing 1]



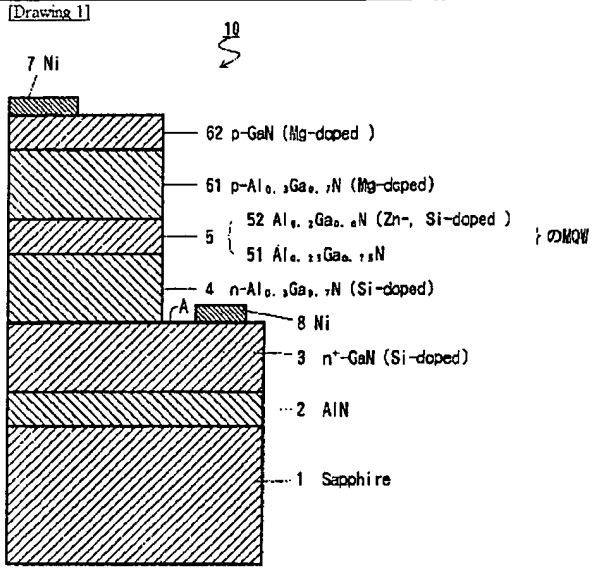
Drawing selection [Representative drawing]



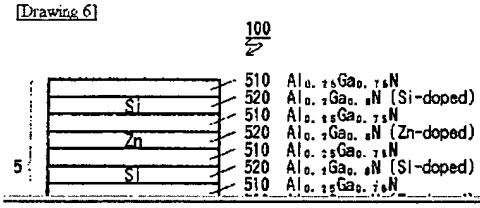
[Translation done.]

JAPANESE | JP.09-153645.A1

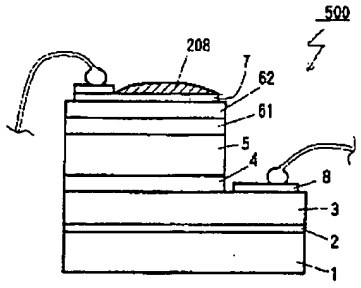
[Drawing 1]



[Drawing 6]



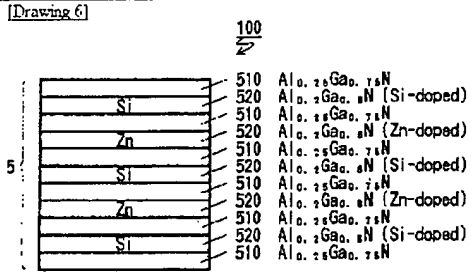
Drawing selection [Representative drawing]



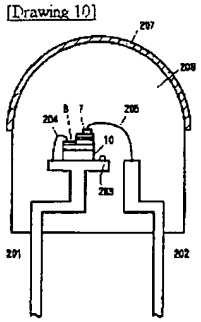
[Translation done.]

JAPANESE | JP.09-153645_A1

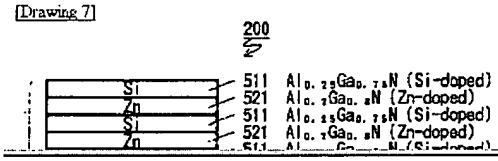
[Drawing 6]



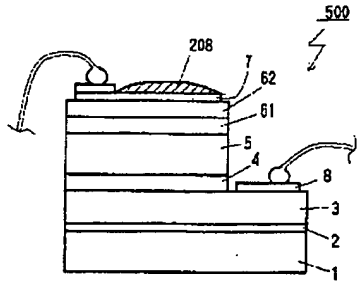
[Drawing 10]



[Drawing 7]



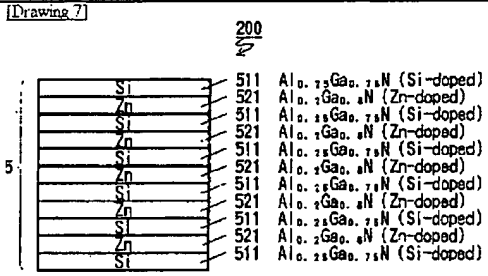
Drawing selection [Representative drawing]



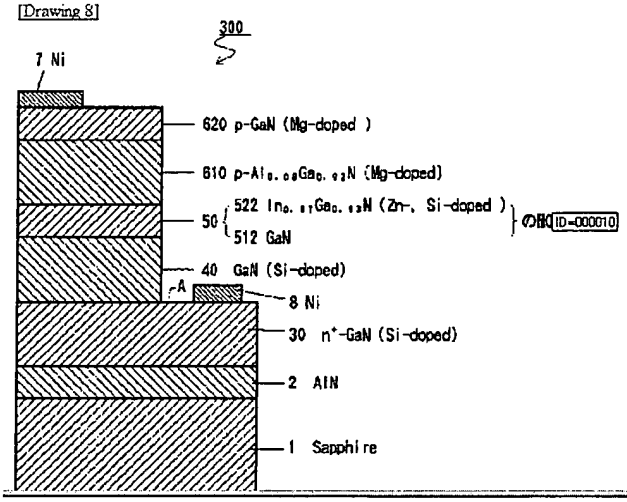
[Translation done.]

JAPANESE | [JP.09-153645.A1]

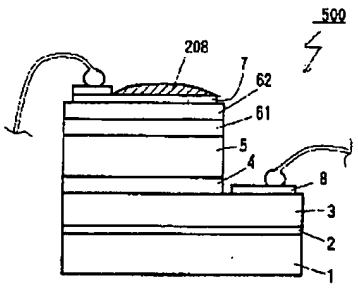
[Drawing 7]



[Drawing 8]

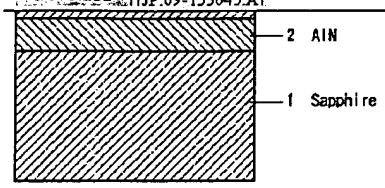


Drawing selection [Representative drawing]

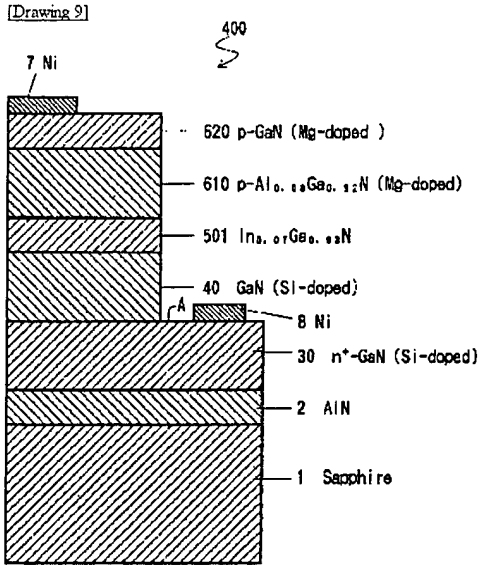


[Translation done.]

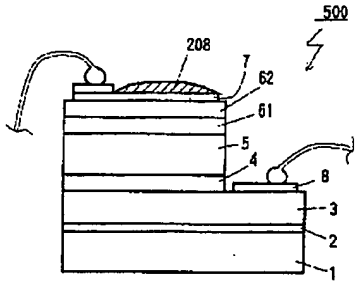
JAPANESE | JP.09-153645.A1



[Drawing 9]



Drawing selection [Representative drawing]



[Translation done.]